

**Cost Benefit Analysis for New Proposed Forest Practices Rules Implementing the
Forests and Fish Report**

Final Report

**Submitted: February 21, 2001
To the Department of Natural Resources
DNR Agreement # FY00-133**

Prepared by:

John Perez-Garcia

**College of Forest Resources
University of Washington
BOX 352100
Seattle, Washington 98195-2100
perjohm@u.washington.edu**

ACKNOWLEDGEMENTS

The authors wish to acknowledge the following individuals for their assistance in implementing the project: Debora Brown-Munguia, Department of Natural Resources (DNR); Cathy Carruthers, DNR; Doretta Collins, DNR, who provided GIS data bases as well as summary tables of water typing; Kim Sellers, DNR; Catherine Elliott, DNR; Charlene Rodgers, DNR, who provided project leadership; Bruce Glass, DNR, who provided project leadership; Nels Hanson, Washington Farm Forestry Association (WFFA); Bruce Lippke, University of Washington (UW); John Ehrenreich, Washington Forest Protection Association; Harold Brunstad, contract logger; Dave Sweitzer, Washington Hardwoods Commission

The study was funded by the Department of Natural Resources under an interagency agreement with the University of Washington FY00-133.

EXECUTIVE SUMMARY

The Forest Practices Board (FPB) must make a determination on whether the probable benefits exceed the probable costs associated with the new proposed forest practices rules. It must also make a determination whether the new proposed rule changes are the least burdensome alternative.

The objectives of the paper are (i) to present costs and benefits for the new proposed forest practices rules (defined as Alternative 2) and (ii) to compare the costs for Alternative 2 with the costs for Alternative 3, which contains a combination of environmental groups and tribal proposals. The study provides information to assist the FPB in their determination of whether probable benefits would exceed probable costs associated with new proposed rule changes. The study also provides information to assist the FPB in the determination of whether the new proposed rule changes are the least burdensome alternative.

The costs considered for the CBA include those costs identified under the Small Business Economic Impact Statement (SBEIS) as well as others not considered in the SBEIS study. The costs considered under the SBEIS include the foregone timber asset value, road planning and implementation costs and forest practices set-up costs. In addition to these costs, the CBA includes the direct and indirect economic impact on the State of Washington from a lower timber harvest.

The benefits considered for the CBA are the public's value of an increased fishery resource over a baseline trend. In addition the CBA considers benefits associated with road construction activities and the tax credit program. A key assumption made in the assessment of an increase in the value of the fishery resource is that the new proposed rule changes will lead to an improved aquatic habitat that in turn leads to an increase in the fish population.

The analysis of costs and benefits provides a breakeven point. The breakeven point depends on programmatic changes that will improve fish populations. The breakeven point suggests that probable benefits exceed probable costs when the new proposed rule changes improve fish populations by the first 5% over baseline trends. If new proposed rule changes lead to less than the first 5% improvement over the baseline population, then the probable benefits would not exceed probable costs. Further, the new proposed rules are assumed to produce the first 5% increment in fish population over all other projects that can benefit fish populations.

The study also provides evidence on the probable costs of Alternative 2 relative to Alternative 3 so that the FPB may make a determination as to whether the new proposed rule changes are the least burdensome alternative to those entities required to comply. Under Alternative 2, the probable costs are at least \$6 billion lower than under Alternative 3. The probable cost associated with Alternative 3 will increase further when employment effects are fully incorporated.

Table of Contents

Acknowledgements	2
Executive Summary	3
Table of Contents	4
Introduction	5
Alternatives under Study	7
Structure of the Cost Benefit Analysis	7
Types of Benefits Associated with Environmental Effects	7
Estimation of the Value of the Fishery Resource	9
Other Benefit Measures	11
Estimates of Cost Data Under Alternative 1	12
A Discussion of Probable Benefits and Probable Costs	14
A Comparison of the Costs Associated with Alternatives 2 and 3	16
Concluding Remarks	17

COST BENEFIT ANALYSIS FOR NEW PROPOSED FOREST PRACTICES RULES IMPLEMENTING THE FORESTS AND FISH REPORTS

John Perez-Garcia, College of Forest Resources, University of Washington

Introduction

New proposed rules for forest practices are under consideration for adoption by the Forest Practices Board. RCW 34.05.328 mandates that “(1) before adopting a rule ..., an agency shall ... (c) determine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented; (d) determine, after considering alternative versions of the rule and the analysis required under ... (c) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection.”

The new proposed rule changes are expected to have environmental effects that will improve aquatic habitat at some cost. While the study presents an estimate of the value of fishery resources that is linked to various programmatic changes, this value is not directly related to habitat changes that can be associated with the new forest practices rules. There is uncertainty surrounding the magnitude of any population response attributable to the rule alternatives.¹ As such, the lack of any available data on the linkage between the habitat effects and population improvements produces uncertainty surrounding the magnitude of benefits associated with the new proposed rules. As a result, the study presents a comparison of benefits and costs conditional on the improvement any habitat change associated with the new forest practices rules might have on fish populations.

While several benefits have proved to be difficult to quantify for the CBA, there are examples of costs that are likewise difficult to quantify. In such instances, qualifying statements regarding the effects of these costs on the comparison of cost to benefits are provided.

Table 1 presents the potential benefits and costs associated with new proposed rule changes. In addition to listing these benefit and cost items, the table includes their measure and potential effect on the benefit or cost figure.

¹ See Botkin, D.B., D.L. Peterson and J.M. Calhoun (technical editors). 2000. The Scientific Basis for Validation Monitoring of Salmon for Conservation and Restoration Plans. Olympic Natural Resources Center Technical Report. University of Washington, Natural Resources Center, Forks, Washington, USA

Table 1. Potential costs and benefits associated with new proposed rule changes.^a

Potential Benefits	Measures and Effects
Improved fishery resource	NPV in dollars for the state
Improved habitat for upland wildlife	Not estimated, will increase benefits
Improved carbon sequestration	Not estimated, will increase benefits
Improved water quality	Not estimated, will increase benefits
Reduced threats to public safety from unstable landforms	Not estimated, will increase benefits
Promote viability of industry in view of other alternatives ^b	Not estimated, will increase benefits
Employment benefits from implementing road maintenance plans	NPV in dollars for the state
Tax credit benefits to landowners/harvesters ^c	NPV in dollars for the state
Potential Costs	Measures and Effects
Lost revenues due to timber asset retirement	NPV in dollars for the state
Net costs associated with road planning and maintenance	NPV in dollars for the state
Setup costs to delineate riparian management zones, unstable slopes, etc	NPV in dollars for the state
Net income losses due to employment losses.	NPV in dollars for the state
Set asides for unstable slopes	Not estimated, will add to costs
Costs associated with the forested wetlands rules	Not estimated, will add to costs
Costs associated with pesticide restrictions	Not estimated, will add to costs
Equipment zone limitation costs (both outside and inside the limitation zone)	Not estimated, will add to costs
Increased harvesting costs outside RMZ	Not estimated, will add to costs
Social and economic dislocation	Not estimated, will add to net income loss figure above
Lower tax revenues due to benefits to landowners/harvesters ^c	NPV in dollars for the state
Loss recreational and fire control access	Not estimated, will add to costs

^aThe non-quantified benefits and costs listed in the above table cannot necessarily be summed to estimate total benefits or costs since the effects are somewhat interdependent and therefore not entirely separable.

^bThe viability of the industry is under less pressure under Alternative 2 than Alternative 3. In this respect, it may be considered a benefit associated with Alternative 2. The CBA does not however assess how viability is likely to change under any alternative, the study draws attention only to the relative change under Alternative 2 versus Alternative 3

^cTax credit benefits accrue to a segment of society (landowners and harvesters) and may also be viewed as a reduction in costs rather than a benefit. These are a transfer of dollars from the state to the landowners and harvesters. They are included to explicitly recognize the costs and benefits of mitigation programs.

Alternatives under Study

The study provides estimates of benefits and costs listed in Table 1 associated with Alternative 2. This alternative refers to the new proposed rules that are being finalized. This alternative makes changes to the existing permanent rules as proposed in the Forests and Fish Report and supplemented by ESHB 2091. The study also compares the costs associated with Alternatives 2 and 3. Alternative 3 refers to combined portions of proposals put forth by tribal and environmental groups. Alternative 3 is constructed with elements of the tribal and environmental proposals. A description of the two alternatives can be found in the Washington Forest Practices Board Draft Environmental Impact Statement² on alternatives for forest practices rules (EIS).

Structure of the Cost Benefit Analysis

The CBA is organized as follows. The types of benefits associated with the rule changes are presented first. The description of these environmental effects is taken from the EIS. The EIS provides a qualitative assessment on the new forest practices rule changes under consideration. The description of the environmental effects is then followed by a discussion of the probable benefits associated with a programmatic change such as the new proposed rules. The section describes the Layton, Brown, Plummer (LBP)³ study and how it is used to value the fishery resource for Washington State. The probable benefits are expressed as the public's value of the fishery resource associated with program changes. As such, the value of benefits associated with the new proposed rule changes must be inferred from likely effects environmental improvements associated with rule changes might have on the fishery resource. The next section describes costs associated with the new proposed rule changes. Estimates of costs are presented for Washington State. The following section discusses the benefit and cost estimates presented. It also identifies where benefits and costs are likely to breakeven. Next, the paper presents the incremental cost associated with Alternative 3. The final section presents a discussion of the conclusions reached in the study and the study limitations.

Types of Benefits Associated with Environmental Effects

The EIS provides qualitative measures of environmental effects associated with rule changes. Alternative 2 modifies forest practices so that the expected environmental effects would further protect public resources which may allow for maintenance of an economically viable forest sector. Alternative 2's goal is to maintain conditions so that a properly functioning forested ecosystem enhances fish species or fish populations. The alternative establishes a projection of changes that will lead to attainment of a properly functioning forest ecosystem. Stronger changes indicate that the attainment of target conditions is more probable than under weaker changes. However the modification of

² Draft Environmental Impact Statement (March 20, 2000) found on Department of Natural Resources website: www.wa.gov/dnr

³ Layton, David, Gardner Brown and Mark Plummer. (1999). Valuing multiple programs to improve fish populations. Unpublished manuscript. Report commissioned by the Department of Ecology. This study is the most recent attempt by economist to value the fishery resource in the State of Washington.

forest practices does not provide certainty that the current fishery resource will be maintained or recovered. A change in fish population depends on multiple factors and programs, of which the new proposed rules is only one. The proposed changes are necessary but may not be sufficient in and of themselves to assure an increase in the fishery resource. As a result, improvements in fish populations under the new proposed forest rule changes have a substantial degree of uncertainty associated with them.

Tables 2 and 3 summarize the outcome of evaluations undertaken in the EIS on environmental components under Alternative 2. The expectation is that by providing an increase in the levels of protection under the new proposed rule changes, there is likely to be an improvement in the fishery resource through an improvement of the aquatic habitat. Moderate to high estimated levels of environmental protection are expected under Alternative 2 for the environmental measures analyzed by the EIS.

Table 2. Estimated Level of Protection for Fish in Westside Streams

Measure	Alternative 2
Coarse Sediment	Moderate to High
Fine Sediment	Moderate
Hydrology	Moderate
Large Woody Debris	Moderate to High
Leaf/Needle Recruitment	Moderate
Floodplains and Off-Channel Areas	High
Water Temperature	High
Forest Chemicals	Moderate to High
Fish Passage	High

Source: Draft EIS, page 3-131 Table 3.7-4

Similarly, moderate to high estimated levels of protection are expected under Alternative 2 for eastern Washington streams. Table 3 lists these estimated levels of protection.

Table 3. Estimated Level of Protection for Fish in Eastside Streams.

Measure	Alternative 2
Coarse Sediment	Moderate to High
Fine Sediment	Moderate
Hydrology	Moderate
Large Woody Debris	Moderate
Leaf/Needle Recruitment	Moderate
Floodplains and Off-Channel Areas	High
Water Temperature	Moderate to High
Forest Chemicals	Moderate to High
Fish Passage	High

Source: Draft EIS, page 3-131 Table 3.7-5

In addition to the stream habitat conditions mentioned above, Alternative 2 is likely to have impacts on wildlife, water quality and carbon sequestration.

Estimation of the Value of the Fishery Resource

Estimates of values associated with the environmental benefits of the new proposed rule changes do not exist. However, a study by Layton, Brown and Plummer (LBP) evaluates the value of changes in five different fish populations to residents of the State of Washington. We use the LBP study to characterize the probable benefits under different assumptions of where fish populations are and which improvements we might see under the new proposed rule changes. The LBP study determines the value of a set of potential programs that would each mitigate impacts on fish populations. Since Alternative 2 is considered a program that can improve the fishery resource, the LBP study can contribute to the study's understanding of the value of the new proposed rule changes under study.

The LBP study uses the Stated-Preference method⁴ to evaluate the changes in values in fish populations in Washington to residents of Washington. Potential harm to fish populations come from urban development, agricultural practices, timber harvesting, pollution, hatcheries and hydroelectric dams as well as predation, and recreational and commercial fish harvesting. The LBP study develops functions that allow the study to evaluate the value of a new program incrementally, conditional upon the amount of fish population improvements to date. The study utilizes a 20-year horizon and solicits responses from resident in the State of Washington. The study evaluates these responses in 5% increments of fish populations.

A limitation that we face is the lack of any fish population estimate and change to fish population due to policy implementation. Therefore, we use the LBP study results to characterize the probable benefits under different assumptions of where fish populations are and how much improvements we might see under the alternatives under consideration. To do so we calculate the willingness to pay by fish species for a 20-year period using the results of the LBP study. The willingness to pay is presented in present value terms using a discount rate of 5.8%, similar to the rate used to determine the present value of cost items in the SBEIS. This present value is calculated over the range of improvements by fish species using the High-Status Quo and Low Status Quo assumptions from LBP.

Figure 1 presents the present value of incremental increase in program value for all households in Washington over a 20-year project period for the High Status Quo assumption. This assumption establishes a constant trend in population over the next ten years as the baseline. The first increment assumes the program increases fish populations by 5% over baseline trend conditions. The mean response is charted in Figure 1. For this first 5% increment in fish populations, the value of the program to all 2 million Washington households is estimated to be \$7 billion. The next increment of 5%--from 6% over baseline trend to 10% over baseline trend--is valued at slightly under \$3 billion.

⁴ Principles for valuing benefits that are not indirectly traded in markets are discussed in a report by the Office of Management and Budget, Economic Analysis of Federal Regulations Under Executive Order 12866.

Each subsequent 5% increment's value declines to nearly \$0.5 billion with an increment from 45% to 50%.

Figure 1. LBP fish values as a function of incremental project success in raising fish population. The incremental initial value 1 is a 5% increase over constant fish population status quo. Value 2 is the increment from 6% to 10%, Value 3 from 11% to 15%, etc.

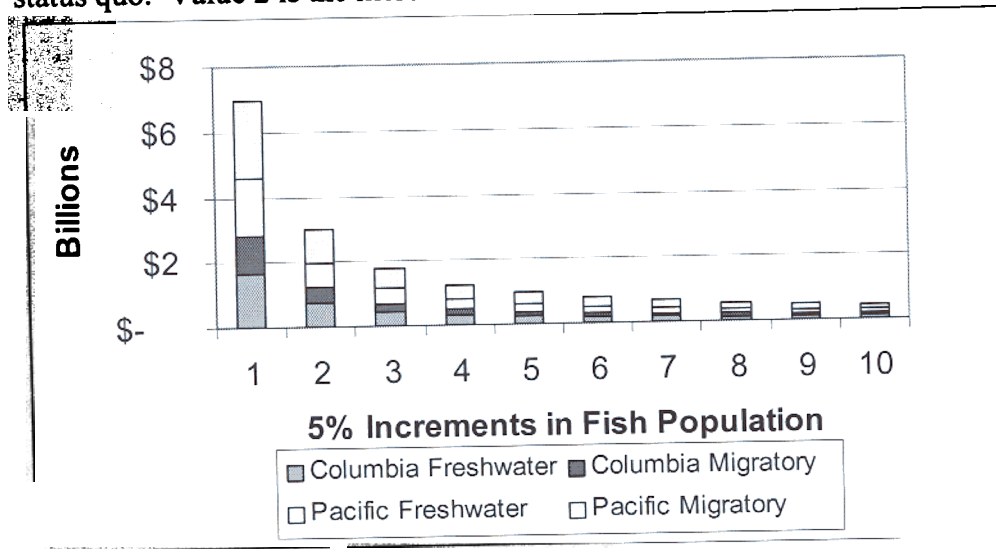
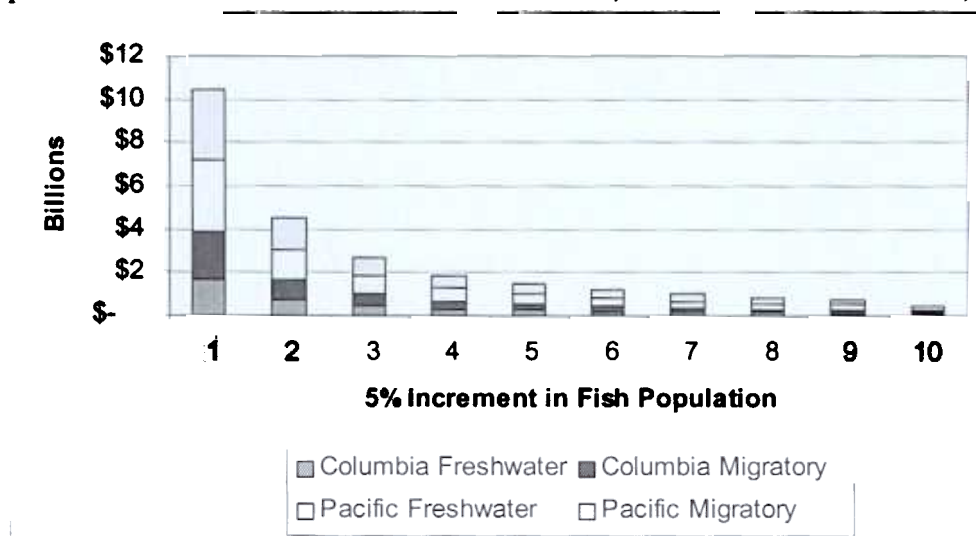


Figure 2 presents the present value of incremental increase in program value for all households in Washington over a 20-year project period corresponding to the Low Status Quo trend: populations of fish would continue to decline over the next 20 years at the same rate they declined during the previous 20 years. As in Figure 1, the first period assumes the program increases fish populations by 5% over baseline trend conditions. For this first 5% increment in fish population, the value of the program to all 2 million Washington households is estimated to be over \$10 billion. The next increment of 5%--from 6% over baseline trend to 10% over baseline trend--is valued at just over \$4 billion. Each subsequent 5% increment's value declines until it reaches nearly \$0.5 billion with an increment from 45% to 50%.

Figure 3. LBP study fish values as a function of incremental project success in raising fish population. The initial value 1 is a 5% increase over declining fish population status quo. Value 2 is the increment from 5% to 10%, value 3 from 10% to 15%, etc.



Other Benefit Measures

In addition to the net increment in the public's value of the fishery resource linked with the potential changes in fish population, there are other potential benefits associated with the new proposed rule changes. The road maintenance and abandonment plan could increase activity in road construction, which is likely to have a beneficial effect on this sector. The road maintenance and abandonment plans are a transfer of value from the forest sector to other sectors in the state. In this section we mention the benefits associated with these plans. Using an input/output approach, the study estimates the contribution of the increase in road activity to the state product to be between \$1.789 billion and \$2.684 billion over the 15-year program period.⁵ The value assumes that all road maintenance and abandonment plans are implemented on forested acres in existence today.

There is also the tax benefit associated with Alternative 2. Similarly to the roads benefits, tax benefits are a transfer from the state to land owners and harvesters. The net present value over a rotation is estimated at \$154 million.⁶ In addition there are benefits associated with the compensation program for small landowners. The compensation benefits are an order of magnitude less than the tax credit benefits presented above. Both programs have the goal of reducing the impact of new rules on landowners and hence reduce their costs. They are mentioned explicitly to recognize the benefits of mitigation

⁵ The range in the effects of the road package on the state's economy is produced by varying the multiplier from 2 to 3, a range that is likely to include the actual multiplier effect.

⁶ The Department of Revenue estimates a figure, \$7.9 million for 2001 to 2003, which when capitalized is less than the above by about \$40 million.

programs while noting that they result in a transfer of payments from the State to landowners and other forest-related businesses.

Estimates of Cost Data Under Alternative 1

Several of the costs associated with Alternative 2 have been identified in the Small Business Economic Impact Statement (SBEIS)⁷. The calculated costs from the SBEIS include lost revenues due to timber asset retirement, the costs associated with road maintenance and planning, set up costs to harvest under rule changes and lost wages in employment in the forest sector. Since these costs were determined from a sample of Washington landowners, they are scaled upward in the CBA to represent statewide effects. Additionally, the CBA assumes there will be a harvest volume response to implementation of the new proposed rules, and that implementation of the rules will not result in a net change in price. In other words, the CBA assumes there will only be a net loss in producer surplus associated with rule implementation and that no net loss in consumer surplus will occur. The SBEIS provides further details of the reasoning underlying this assumption.

Table 4 presents the costs associated with Alternative 2 for the sampled sections in western and eastern Washington. The estimated total parcel value for timber is also given. The breakdown of costs into the three buffer types for Alternatives 2 is also provided.

Table 4: Net timber asset value of sampled parcels under different alternatives.

	Timber Asset Values			
	Western Washington		Eastern Washington	
for Total Parcels	\$	145,780,245	100%	\$ 8,420,291 100%
for Alternative 2	\$	15,935,892	10.93%	\$ 660,795 7.85%
for S and F Waters	\$	14,814,857	10.16%	\$ 621,106 7.38%
for N _p	\$	1,121,035	0.77%	\$ 39,688 0.47%
for N _s	\$	0		\$ 0

Source: SBEIS. S and F waters are shoreline and fish-bearing streams. N_p waters are non fish-bearing perennial streams. N_s waters are non fish-bearing seasonal streams.

The largest impact is on shoreline and fish-bearing streams. Its worth noting that the buffers surrounding these streams contain a larger percentage of hardwood resources.⁸

⁷ See Small Business Economic Impact Statement for Proposed Forest Practices Rules Implementing the Forests and Fish Report. Final Report Submitted to the Department of Natural Resources. Dec 18.2000

⁸ The distribution of riparian zone management acres between hardwood, mixed and softwood vegetation types is noted in the SBEIS. That study finds more hardwood vegetation located in the core zone and among small land owners. Conversion of hardwood vegetation type to a softwood type is likely to be more difficult for these smaller ownerships and hence reduce the benefits that a well functioning forested ecosystem can produce.

Without management of these resources, the buffers are not likely to achieve the level of environmental effects noted previously. Hardwood conversion is necessary to maintain the forested ecosystem from reverting to a vegetation type that is not likely to produce the aquatic habitat associated with a well functioning forested ecosystem.

In addition to the cost associated with the lost timber revenues, increased road costs occur under Alternative 2. Table 5 illustrates the costs associated with rule changes affecting road maintenance and abandonment plans for Alternative 2. The NPV of the costs over the 15-year time horizon yields a cost for the sampled sections of nearly \$14 million.

Table 5. Net Increase in Road Cost for Alternatives 2 and 3

	Western Washington	Eastern Washington
Alternative 2 (Total)	\$9,647,372	\$4,056,623

The above costs are representative of a sampled section of the State of Washington. The forested area sampled and total Washington State forested acres are presented in Table 6. Using the percent sampled factor, we derive costs for the state. These cost estimates are presented in Tables 7 and 8.

Table 6. Total and Sampled Forested Area in Washington State

	Total State Forested Area (AC)	Forested Acres Sampled (AC)	Percent Sampled (%)
Westside	6,488,320	40,000	0.6%
Eastside	3,229,440	21,328	0.7%

Table 7. Net State-wide Timber Asset Values

	Timber Asset Values			
	Western Washington		Eastern Washington	
for Total Parcels	\$23,646,721,980		\$1,182,296,720	
for Alternative 2	\$2,584,929,169	10.93%	\$92,782,513	7.85%
for S and F Waters	\$2,403,088,324	10.16%	\$87,209,763	7.38%
for N _p	\$181,840,845	0.77%	\$5,572,609	0.47%
for N _s	\$0		\$0	

Table 8. Net State-wide Road Maintenance Costs

	Western Washington		Eastern Washington	
Alternative 2	\$1,564,880,917	6.62%	\$569,592,199	48.18%

Most setup costs will involve greater levels of forestry services. Landowners will bear the costs while forestry professionals will have more work. These riparian management zone setup costs will be mostly a transfer of costs within the forest sector. They are estimated at \$154 million.

The employment effects may be quite large. Employment effects are captured as lost wages. The study calculates these lost wages using input/output tables produced by Richard Conway (1994)⁹. The 1994 study produced an estimated impact of the forest products sector on Washington's economy. The study also produces the net effect on lost wages and tax revenues for a 5.97% reduction in timber harvests due to federal harvests declines. Assuming the multipliers associated with Washington State economy are similar today as they were in 1992, the study calculates the impact of a 9.4% statewide timber harvest reduction. The results are presented in Table 9.

Table 9. Wage costs under Alternative 2 (million dollars)

	Annual	PV over a ten year period (million dollars)	
		30% decay over 10 years	30% decay over 5 years
Wage Costs	\$ 881	\$3,420	\$2,387

Three estimates are provided in Table 9. The annual figure of \$881 million represents approximately 6% of the total gross state product. Two estimates of the present value of the wage bill are also given in Table 9. The first estimate of \$3.4 billion reflects a 30% decay over a 10 year period. The second estimate of \$2.4 billion reflects a 30% decay over a 5 year period. A decay function is used to measure the diminishing effect of displaced workers unable to find new employment over time. The 30% reflects an assumption that even after a period of time, 30% of workers will still be displaced by the new proposed rules.

There are additional lost revenues from lower wood product sales, loss tax receipts and early retirement of capital that are not reflected in the study.

A Discussion of Probable Benefits and Probable Costs.

The range of probable benefits associated with an increase in the fishery resources is from \$7.0 to \$10.6 billion for the first 5% increase in fish population according the LPB study. Any larger increase in fish population will result in a larger value for the fishery resource. Should the new proposed rules result in an increment that is not the first 5% then the benefits of Alternative 2 will be reduced.

In addition to the increase in fishery resource value, should the road maintenance and abandonment plans be fully realized, the road construction sector would accrue an additional benefit between \$1.789 and \$2.684 billion. Smaller benefits will also be

⁹ Conway, Richard. 1994. The Forest Products Economic Impact Study: Current Conditions and Issues. Prepared for the Washington Forest Protection Association, the Washington State Department of Natural Resources, the Washington State Department of Trade and Economic Development.

realized through the tax credit program and set-up costs: an estimated \$154 million dollars for each item. With these four components of benefits, a range of probable benefits is from \$9.1 billion to \$13.3 billion if the changes in forest practices result in at least the first 5% increment in fish population over baseline trends and all eligible tax and road programs are implemented. The range is likely higher should we consider the non-quantified benefits listed in Table 1.

The costs associated with Alternative 2 are comprised mainly of the inability to realize timber sale revenues, the implementation of road maintenance and abandonment plans, the direct and indirect employment effects, the associated tax revenues and the set-up costs. The foregone timber sale revenues reach \$2.7 billion. Lost wages add from \$2.4 to \$3.4 billion. The road costs can add an additional \$2.1 billion. Costs associated with reduced excise tax receipts and setup costs add an additional \$308 million. A range of probable costs is from \$7.5 billion to \$8.5 billion. However, other non-quantified costs, such as for seeps, unstable slopes and pesticide restrictions are likely to result in a larger figure.

Since there is a substantial decline in fishery resource value from the first 5% increment to the second 5% increment, the breakeven point for benefit equating cost is likely to be associated with the first 5% increment in fish population. Any larger increment in fish population would result in a greater benefit. Any smaller increase in fish population would reduce the probable benefits to below probable costs. Also, should the new rule changes affect fish populations other than the first 5 %, the benefits are also likely to fall below the costs associated with Alternative 2.

Table 10. Summary Table for Benefit Cost Analysis (Billion dollars)

	Net costs over Alternative 1		Net benefits over Alternative 1	
	Low	High	Low	High
Foregone timber asset value	2.678	2.678		
Road maintenance & stream crossings	2.13	2.13		
Lost wages ^a	2.387	3.420		
Set up costs	0.154	0.154	0.154	0.154
Hypothetical FIRST 5% increase in fish population after 20 years			7.0	10.3
Increased road construction activity			1.789	2.684
Reduced excise tax	0.154	0.154	0.154	0.154
TOTALS	7.503	8.536	9.097	13.292

^aLow range of lost wages assumes displaced workers reenter the work force within 5 years of displacement; high range of lost wages assumes displaced workers reenter the work force within ten years of displacement.

^bLow range of FIRST 5% increase in fish population after 20 years is associated with a HIGH STATUS QUO assumption (that fish population will remain at first year levels for next 20 years); high range of FIRST 5% increase in fish population after 20 years is associated with a LOW STATUS QUO assumption (that fish population will continue to decline over the next 20 years at the rate of decline observed over the past 20 years).

^cLow range of increased road construction activity assumes a multiplier effect of 2.0; high range of increased road construction activity assumes a multiplier effect of 3.0.

Table 10 summarizes the various quantified benefits and costs presented in the study. For several values a low and a high figure is provided. The low and high figures refer to alternative assumptions used to calculate values. These assumptions are listed in the table notes. Numbers in italics are considered value transfers—a change in cost with a corresponding change in benefits. The last line in Table 10 summarizes the total costs and benefits. While the range in benefit values is higher than the range in costs, the totals represent the breakeven point since (i) assuming a larger than the first 5% increased effect of the new proposed rules on fish populations would make benefits further exceed costs and (ii) assuming a smaller than the first 5% effect of the new proposed rules on fish population or if the forestry activities contribute to a change in fish population that is not the first 5% increment, then benefits are likely to be less than costs.

A Comparison of the Costs Associated with Alternatives 2 and 3

To consider whether Alternative 2 is least burdensome, the study analyzes the incremental costs associated with Alternative 3. Table 11 presents the net increment in costs associated with additional buffer requirement of Alternative 3. For shoreline waters and fish-bearing streams, Alternative 3 will increase statewide losses in timber revenues by nearly \$4 billion over Alternative 2. Extended buffers on non fish-bearing perennial streams cost nearly \$580 million over Alternative 2. The costs associated with seasonal non fish-bearing buffers would be nearly \$1.2 billion. Alternative 3 would reduce timber asset values by one quarter to one third over the reductions associated with Alternative 2.

Table 11. Net state-wide timber asset values (values are net of Alternative 2 costs)

	Timber Asset Values			
	Western Washington		Eastern Washington	
for Alternative 3	\$5,366,379,332	22.69%	\$381,054,964	32.23%
for S and F Waters	\$3,686,485,481	15.59%	\$301,225,735	25.48%
for N _p	\$547,662,059	2.32%	\$32,687,689	2.76%
for N _s	\$1,132,231,791	4.79%	\$47,141,539	3.99%

In addition to the lost revenues associated with wider buffers under Alternative 3, there would be additional costs associated with a shorter timetable for road maintenance and abandonment plans. These costs will increase the cost burden associated with Alternative 3, although from a Washington State perspective they are likely to be offset by increased road construction sector activity.

Table 12. Net State-wide Road Maintenance Costs

	Western Washington		Eastern Washington	
for Alternative 3	\$207,538,161	0.88%	\$75,540,673	6.39%

The net employment effects would also increase as less timber would flow through the forest sector and there would be a reduced contribution of this sector to the statewide

economy. These net employment costs may be as large as the timber asset value reduction and road maintenance and abandonment plan costs, adding a substantial increment to Alternative 3 costs. They are not estimated in the study since the volume impact of Alternative 3 has not been estimated.

Table 13 provides the net costs over Alternative 2 associated with Alternative 3. Various costs have not been calculated, but are expected to add to the net costs associated with Alternative 3. These costs are represented in Table 13 with a plus “+” sign.

Table 13. Incremental costs associated with the Alternative 3 (billion dollars).

	Net costs over Alternative 2
Foregone timber asset value	\$5.747
Road maintenance & stream crossings	\$0.283
Lost wages	+
Set up costs	+
TOTALS	\$6.031+

Concluding Remarks

The study presents benefits and costs associated with the new proposed rule changes. Benefits are measured as the value of the fishery resource estimated as the willingness to pay for an increase in fish population under a set of programs. In addition, other benefits include the contribution that road maintenance and abandonment planning would have on the road construction sector in Washington and the effects of a tax credit associated with the salmon recovery program. Benefits not quantified for the study include the probable benefits of adopting Alternative 2 on industry viability over Alternative 3 and environmental benefits associated with improved habitat for wildlife and other aquatic species, improved water quality, improved carbon sequestration and reduced threats to public safety from unstable landforms.

The cost analyzed for the study include loss timber revenues, lost employment and the associated wages and tax revenues (direct and indirect effects) and the road maintenance and abandonment plans. Other costs not included in the study are potential costs from unstable slope restrictions, costs associated with the forested wetlands rules, costs associated with pesticide restrictions, equipment zone limitation costs, social and economic dislocation costs and loss recreational and fire control access.

A comparison is made of the benefits and costs that are quantifiable. A breakeven point is presented where these benefits just exceed costs. The breakeven point is where the benefits are above costs if the new proposed rules would improve fish populations by the first 5% over baseline population levels.

The study has several limitations. Perhaps the greatest limitation is that there is no data that directly links the environmental effects from new proposed rules effects with a change in fish populations. Another limitation is the valuation of the fishery resource

implemented under the LBP study. The study was designed to analyze a set of programs that can improve the status of the fishery resource in the State of Washington. As a result there is no possible ranking of programs that can be made to place the new rules within the set of potentially beneficial fish programs. Programs in other sectors can potential have a higher value of the fishery resource than the new forest practices rules. These other programs may also have lower values.

Other benefit studies that have attempted to value the fishery resources do not provide any reduction in the study's uncertainty with respect to the contribution of the new forest practices rules to the benefits associated with the fishery resource. An analysis by Xu (1997)¹⁰ estimates biodiversity values. At its maximum, the present value of annual benefits over a 20-year period is equivalent to \$6.2 billion, near the bottom range of the LBP value for the fishery resource.

¹⁰ Weihuan Xu. 1997. Experimental choice analysis of non-market values for ecosystem management with preference heterogeneity. Unpublished Ph.D. dissertation. University of Washington, College of Forest Resources.